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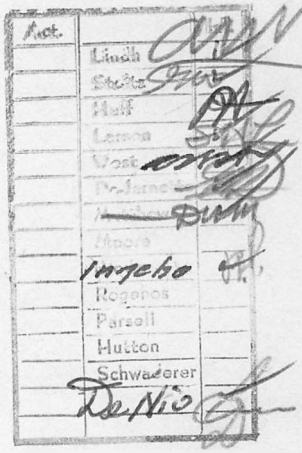

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE
DIVISION OF FOREST INSECT INVESTIGATIONS

ENTOMOLOGICAL PHASES OF THE 1952 SPRUCE BUDWORM CONTROL PROJECT

Bitterroot National Forest, Montana

Including

An Abstract of the
REPORT ON THE SPRUCE BUDWORM CONTROL PROJECT
EAST FORK OF THE BITTERROOT RIVER
By Corland L. Janes, Project Officer
Bitterroot National Forest, Montana

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Forest Insect Laboratory
Coeur d'Alene, Idaho
July 28, 1952

Entomological Phases of the 1952 Spruce Budworm Control Project, Bitterroot National Forest, Montana[1/]

INTRODUCTION

An estimated 11,974 acres of Douglas-fir forests infested with the spruce budworm (Choristoneura fumiferana Clem.) were sprayed from the air during the morning hours of July 9 and 10, 1952 to control a portion of the current epidemic outbreak of this insect in the east fork of the Bitterroot River basin, Bitterroot National Forest, Montana. The operation was the first attempt to control the many currently extensive budworm infestations in the northern Rocky Mountains. From 1947 these infestations have increased in extent and severity until they now cover approximately 2 million acres of forested land in this region. The Bitterroot infestation is contained in parts of the west and east forks of the Bitterroot River south of the town of Darby.

The funds available for budworm control in the region during the present fiscal year necessitated the selection of a 12,000-acre block of the most heavily defoliated timber upon which to concentrate the control effort. Such a block was located in the east fork of the Bitterroot River east of Sula in the midst of an area of approximately 100,000-acres of budworm-infested forest. The entomological justification for treating only 12,000 acres of the 100,000-acre infestation was based upon the following facts:

1) further defoliation would have resulted in extensive tree mortality in the 12,000-acre control block.

2) the defoliation on the remaining 88,000 acres is relatively light and the trees can withstand at least 2 more years of defoliation[2/].

3) the per-acre expenditure of control funds on the control block would effect the killing of the greatest number of budworm larvae per acre.

4) the spraying of only a portion of the present infestation would allow the continued build-up of parasite and predator populations or diseases which, it is hoped, may effectively control the budworm population in the unsprayed areas in time to prevent excessive tree mortality.

1/ Compiled by Philip C. Johnson, Entomologist

2/ It should be kept in mind that the budworm normally feeds on the current season's new foliage only and not upon the entire foliage complement of the tree in any one season.

The decision to spray the Bitterroot infestation, frankly, was a test of the validity of the above justification as an aid in guiding the future budworm control programs in the region.

The work of the laboratory staff assigned to the control project was greatly facilitated by the accomodations, assistance, and other conveniences furnished by District Ranger Verne Hamre and Alternate Ranger Jack Warren of the Sula District, Bitterroot National Forest, and by Corland L. James, forest project officer and control project supervisor.

RESPONSIBILITIES OF THE LABORATORY

Insecticide Formulation

A standard DDT-oil solution developed by the Bureau in recent years for the control of defoliating forest insects was selected for the project. The formulation was similar to that used in the 1952 budworm control program in Oregon and consisted essentially of the following ingredients:

DDT, technically pure	1 pound
Hydro-carbon solvent	1 pint
#2 fuel oil, to make	1 gallon

The formulated mixture was delivered by the manufacturer at Portland, Oregon to Hamilton, Montana. The contract with the aerial spraying operator required the spraying of one gallon of the above mixture per acre with a spray particle size of from 50 to 150 microns.

Pre-control Surveys

The seriousness of the Bitterroot infestation was determined from the 1951 ranger insect report of the Bitterroot National Forest and from a follow-up examination by James C. Evenden of the laboratory during October 1951. Beginning the latter part of May, Robert E. Denton of the laboratory spent 2 weeks making an appraisal survey of the Bitterroot infestation to select and accurately locate the 12,000-acre block to be treated. The criteria used were (1) the budworm population density, (2) the degree of defoliation, and (3) the relation of these factors to the apparent value of the host type.

Development of 1952 Budworm Brood

Investigations by other laboratories of this Bureau and the experience of the few previous budworm control projects in the New England states, eastern Canada, and, more recently in Oregon, have indicated that the budworm can be controlled by aerial spraying only when the greater part of the population to be treated is in the 5th larval instar. Since this stage in larval development exists in any one place only for a period of 2 weeks more or less, its determination becomes the key to the correct timing of the spraying.

Mr. Denton first made a collection of 1951-52 overwintering budworm hibernacula from the Bitterroot area on March 20, 1952 to establish the fact that there would be a budworm population in the proposed control area of

sufficient magnitude to warrant continuation of control planning. Forced rearing of overwintering larvae from the hibernacula at Coeur d'Alene during the remainder of March indicated that the budworm brood in the control unit would be quite heavy.

Late in June Mr. Denton began a series of almost daily observations of the natural 1953 budworm population in the proposed control unit to observe the rate of larval development and to detect any evidence of abnormal larval mortality. By July 3 these observations indicated that the bulk of the budworm population would be in the 5th larval instar by July 7 and that spraying could begin on that date.

Checking Spray Deposition

Checking the deposition of the aerial-dispersed DDT-oil insecticide was accomplished by (1) directly intercepting the falling spray droplets on glass plates and vegetation surfaces and by (2) visual observation of the spray airplane flight courses and the settling spray. Clear glass plates 4 by 4 inches in size were placed on the ground at 25-foot intervals and for a distance of 900 feet across the planned lines of flight. After an interval of one hour after spraying the plates were collected and the insecticide droplet pattern compared with photographic prints of similar plates calibrated by droplet size and number of droplets for various dosages per acre.

The droplet size and droplet dispersion pattern on the Bitterroot project compared quite favorably with those signifying a spray dosage of 1 pound of DDT per acre.

Additional indication that this dosage was applied over most of the area was obtained from (1) the similar spray droplet pattern on broadleafed vegetation (principally wild strawberry and Oregon grape), (2) a noticeable lack of doubling or skipping of spray swaths as observed by most Bureau and Forest Service employees who were in a position to watch much of the actual spraying operation both mornings, and (3) the ratio of the number of gallons of insecticide used to the number of acres sprayed.

While the number of gallons sprayed per spray unit is not a true criterion of the acre-per-acre dosage, it does indicate the approximate average per acre dosage in each unit and it serves to keep the airplane pilots informed as to whether a given acreage is being sprayed too light or heavy. The following tabulation is a breakdown of the gallons of insecticide applied on each unit:

Unit	Type of Spray Airplane	Date Sprayed	Pilot	Acreage of Unit Sprayed	Gallons of Insecticide Used
F-1	Ford	7/9-10	Dillon	2,795	2,805
D-2	DC-3	7/9	Ellison	1,151	1,149
D-3	DC-3	7/9	Ellison	2,380	2,385
D-4	DC-3	7/10	Ellison	2,118	2,115
D-6	DC-3	7/10	Ellison	570	568
F-5	Ford	7/9	Johnson	1,610	1,609
F-7	Ford	7/10	Johnson	1,350	1,354
				11,974	11,985

The spray deposition work was done by Archie L. Gibson of the Laboratory, assisted by Gerald Haacke of the Bitterroot National Forest staff. Progress records of the acreage sprayed and the gallons of insecticide used were maintained by Corland L. James, control project supervisor, detailed from the Bitterroot National Forest staff.

Effectiveness of Spraying

Approximately 95 per cent of the budworm population in the treated area was killed by the action of the insecticide.

This conclusion is based upon a comparison of the average budworm population per tree twig terminal tallied at selected locations immediately preceding the spraying and again one week following spraying. The 5 per cent of the population not affected by the spraying had reached the prepupal or pupal stage at the time of spraying and was adequately protected from contact with the insecticide by reason of its immobility and its encasement in a webbed cocoon-like structure. Some 6th instar larvae not in the prepupal stage, as well as all 5th instar and younger larvae, apparently succumbed from the lethal effects of the insecticide.

Another indication of the effectiveness of the spraying was the tremendous larval drop that followed the spraying. Within minutes after the overhead passage of the spray plane and the infiltration of the insecticidal mist into the tree crowns, budworm larvae began dropping from the branches on long silken threads. So numerous were the threads that many of the larger-crowned trees appeared to be festooned with a gauze-like mantel.

CONCLUSION

From all indications the 1952 Bitterroot Spruce Budworm Control Project was highly successful in reducing the population of budworms in the area treated. The duration of the control effect will depend in a large

measure upon the rate of increase in the population which survived in the treated area and of infiltration of the treated area by budworm populations from surrounding untreated areas.

REFERENCES

James, Corland L. Report of the spruce budworm control project, east fork of the Bitterroot River, Bitterroot National Forest, Hamilton, Montana. July 23, 1952.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Bitterroot National Forest

S
CONTROL - Bitterroot
Insect
Spruce Budworm

Hamilton, Montana
July 23, 1952

An Abstract of the

REPORT ON THE SPRUCE BUDWORM CONTROL PROJECT

EAST FORK OF THE BITTERROOT RIVER

INTRODUCTION

On the mornings of July 9 and 10, 1952, approximately 12,000 acres of the Douglas-fir timber type were aerial sprayed with a DDT and fuel oil mixture on the East Fork of the Bitterroot River for the purpose of controlling the spruce budworm. The Johnson Flying Service of Missoula, Montana, did the spraying. Twelve thousand gallons of the insecticide mixture were distributed.

PRELIMINARY PLANNING

Spruce budworm infestations have been known to exist on the Bitterroot Forest since the early 1930's. However, no infestation of epidemic proportions was known to exist until recently on the East and West Forks of the Bitterroot River.

Preliminary planning for the control of infestation in these two areas was started on approximately May 12, 1952, when funds for the project were made available.

Maps and aerial mosaics were made of the area to aid in the planning and for the use of the spray pilots in flying the area. Signed Release of Liability forms were obtained from all property owners within and adjacent to the area sprayed. A bee yard survey of all the apiaries in the upper Bitterroot Valley was conducted and all the major owners of beehives contacted. This was done to avoid any possible chance of dropping spray on bees, and to avoid, if possible, the flight of spray planes over the bee yards in ferrying back and forth from the Hamilton airport and the East Fork River. While no spray was dropped going to and from the area, it was thought that it would be a good precautionary and psychological measure to go around bee yards.

News items were printed in the three local newspapers before and after the spray operation. Movie films on the Tussock Moth Control in northern Idaho, 1947, were shown before six different civic, fraternal and church groups locally. A news reporter for the Ravalli Republican daily paper was conducted on a tour of the operations starting at the airfield, and continued on through to on-the-ground observation of the effects of spraying. A very elaborate and well-written story appeared in the daily paper following the trip.

The public knowledge on the spray project was widespread, and their storehouse of information on the subject was very gratifying as indicated by the frequent questions asked. The reaction was favorable towards the spray project.

Storage for the insecticide was obtained from the local representative of The Texas Company. Upon receipt from the motor transport tanker the insecticide was stored in an 18,000-gallon tank in Hamilton. The insecticide was obtained from the Pennsylvania Salt Manufacturing Company of Washington, and was hauled from a spray project in western Oregon. The transfer of the insecticide from the storage tank to the airfield was by means of gasoline tanker trucks.

The average flight distance from the Hamilton airport to the project was 30 miles. At first this distance was considered excessive for ferrying the insecticide. Search was made for a closer landing strip, both from the air and from the ground. No suitable strip, ready for use with no maintenance or small amount of maintenance, was located. Sites for adequate air strips were available, but the time and cost for constructing a landing field and providing for the minimum facilities that go with a landing field were out of range of this small project. Permission was obtained from the Ravalli County Commissioners to use Hamilton airfield, and the Montana Water Conservation Board generously donated the use of the Hamilton airport office for our dispatching service.

A temporary weather station was established at Guide Creek Summit, located in the approximate surface center of the area, and with an elevation that favored the higher altitudes. A wind guage was installed at the site as a check on the wind velocity at the higher altitudes. A thermometer was installed to check for maximum temperatures. Radio communication was provided from the weather observation station to the Sula Ranger Station. From the Sula Ranger Station to the Hamilton airport, communication was by means of commercial telephone.

The same weather observations were taken at Sula Ranger Station to obtain data at the lower elevations. Successful flight of plane and distribution of spray over the infested area depended upon wind velocity of less than 6 miles per hour and a maximum temperature of 68 degrees F^{0} or less.

Representatives of the Bureau of Entomology and Plant Quarantine made frequent checks on the development of the spruce budworm in larval stages beginning May 26 and up to the time actual spray operations started. The period of effective mortality by spraying is short and the spraying must be timed so as to catch the majority of the spruce budworm larvae in the right stage of development. The progress of the successive molts of the larvae were slow due to the cold and rainy weather experienced during the month of June.

On July 7, representatives of the government agencies concerned with the project met with the Johnson Flying Service, who contracted to spray the insecticide, at Halo Field in Missoula.

In the afternoon of July 8, two spray pilots from the Johnson Flying Service, and one representative each from the Forest Service and the Bureau of Entomology and Plant Quarantine, travelled by air over the project area for the purpose of establishing flight block boundaries and correlating the boundaries on the map with those on the ground.

RECORD OF SPRAYING FLIGHTS

The first flight on the morning of July 9 started at 4:35 A. M. Three planes took part, described as follows:

2 - Tri-motor Fords - Insecticide Capacity - 400 gal. ea.
1 - Douglas C-47 - " " - 900 " "

Wind velocity and temperature at time of first flight were as follows:

	W. V.	Temp.
Guide Creek Saddle	5.5 mi. per hr.	48
Sula Ranger Station	No wind	42

No fog on the East Fork River.

Each plane made four round trips on July 9, making a total of 12 round trips, with a total of 12 hours flying time and average of one hour per each round trip. The last flight was completed at 10:20 A. M. Period of spraying time was 5 hours, 45 minutes. Each plane flew an average of 4 hours each, making it a lump sum time of 1 hour, 45 minutes, chargeable to loading for all planes. There was a total of nine loadings made during the morning - three to each plane. One hour and 45 minutes, divided by 9, equals 11-2/3 minutes of loading time per plane.

Wind velocity and temperature at 9:15 A. M. when the last plane took off for the last trip of the morning were as follows:

	W. V.	Temp.
Guide Creek Saddle	4.0 mi. per hr.	70.0
Sula Ranger Station	2.0 " " "	65.0

Since the guide line for maximum temperature for suitable distribution of spray is 68 degrees, it was decided to stop the flights for the day even though the wind velocity was still below the standard maximum of 6 miles per hour.

It was computed that the total acreage covered for the day was 6,974 acres, and the gallons of insecticide used, 6,960, making approximately one gallon per acre of insecticide distributed.

The first flight on the morning of July 10 started at 4:20 A. M. Weather records were as follows:

	W. V.	Temp.
Guide Creek Saddle	5.5	51
Sula Ranger Station	3.0	50

No fog on the East Fork River

Each plane made three round trips on July 10, making a total of 9 round trips with a total of 10 hours, 49 minutes, and an average of 1 hour, 12 minutes per trip. The last flight was completed at 9:28 A. M. Period of spraying time was 5 hours, 8 minutes. Each plane was in flight for an average of 3 hours, 36 minutes, making a total time of non-flight 1 hour, 32 minutes, or an average of 15 minutes between flights for each plane.

The longer average flight time of the second day, as compared with the first day, was due to the fact that the spray runs were shorter the second day, consequently more time was spent by the planes in turning around than usual. In other words, it took the planes longer to unload the insecticide. Most of the second day's spraying was confined to the south side of the East Fork River where the topography is steeper, which results in shorter runs.

Wind velocity and temperature at 8:50 A. M. during the third and last flight of the day and the project, were as follows:

	W. V.	Temp.
Guide Creek Saddle	4.0	68
Sula Ranger Station	1.0	63

The total acreage covered the second day was 5,000 acres, and the gallons of insecticide used, 5,025 gallons, again making approximately 1 gallon of insecticide per acre.

SUMMARY

Total Flight Time	-	22 hrs. 49 min.
Quantity of Insecticide	-	11,985 gallons

Cost Accounting:

Cost of flying		
Douglas C-47 - 7 hrs. 37 min. @ $195.00		$ 1,485.25
Ford -15 " 12 " @ $100.00		1,520.04
Total		$ 3,005.29
Miscellaneous Costs as follows: Reconnaissance flights, trips of planes from Missoula to Hamilton, and return, use of tanker trailer		$ 406.23
Total		$ 3,411.52
Cost per Acre - $0.28		
Cost of Insecticide, 11,985 gal. @ $0.5918		$ 7,092.72
Freight Cost		1,588.45
Total		$ 8,681.17
Cost of Storage and Delivery of Insecticide		$ 180.00
Cost of Labor, Overhead & Equipment		1,811.80
Grand Total		$ 14,084.49
Cost per Acre - $1.18		

SUBSEQUENT OBSERVATIONS OF EFFECT OF SPRAYING

On July 14 I made a survey of the East Fork River and tributaries to observe the effects of the insecticide on insects, fish, birds and domesticated animal life. As soon as the spray areas were entered, the lack of insect life was very apparent.

No live spruce budworm larvae were observed within the treated area, but when I travelled up a small drainage across from Jennings Camp Creek, I did see numerous live larvae in the fifth and sixth instar stages. This particular area was not sprayed because the insecticide ran out before it was reached.

Reactions of the people living within the treated area were very favorable. Their livestock is no longer bothered by flies. The housewives are pleased to be relieved of the burden of fighting insects in their homes for a short period at least.

SUGGESTED IMPROVEMENTS FOR FUTURE OPERATIONS

1. One of the weaknesses of the spraying operation was the lack of concise boundary markers on the ground. Where the insecticide was sprayed to a main ridge top the boundary was definite, but where the boundary was located halfway up a stream, the plane pilots had difficulty in determining the boundary of spray area. Sometimes they went beyond or fell short. This did not happen too frequently. The pilots are to be commended on their accuracy in determining boundaries and distributing the insecticide without too much overlap or leaving gaps.

It is recommended that in the future where there are no ridge tops, or other definite natural means, to mark boundaries, that the outer edge be marked with large flags or balloons. Some sort of marker is needed.

2. It is recommended that high-speed pumps and larger size hose be purchased instead of depending on gasoline pumps. The usual commercial gasoline pumps are too slow in loading the planes where minutes count. The period of effective spraying is short, and in order to prevent any undue delay pumps must be provided that will do the job with dispatch.

3. In preparing for the East Fork project, a mosaic picture was compiled from 1936 contact prints. The time was too short to make a first-class mosaic, but we did the best we could under the circumstances. Creeks and ridges were accentuated by white lines and figures on the photograph.

4. It is suggested that new pictures be taken of any area that is proposed for spray work. Old photographs are minus the man-made features such as roads, cut-over areas, etc. All these things help the pilot in orientation.

5. Pilots prefer one inch to mile scale maps for flying. Two inch maps are a little too large and one-half inch maps are too small.

In conclusion I might add that the project was very successfully executed on the part of all concerned, and the whole maneuver was well organized. There were no lost-time accidents, or accidents of any description connected with the project.

(Signed) Corland L. Janes

Forest Service, Missoula, Montana

File

Chief, Forest Service, Washington, D.C. August 5, 1952

P. D. Hanson, Regional Forester, R-1, By

Acting

S - CONTROL - Bitterroot - Insect - Spruce Budworm

The spraying of the spruce budworm area on the Bitterroot National Forest was completed on July 10. Attached is a report from the Bitterroot which gives a very full narration of the project and the actual project costs. The rates per hour for the planes used were the regular flying rates in effect with the contract we have with the Johnson Flying Service. An additional supplementary agreement covering principally safety and liability clauses was executed with the Johnson Flying Service prior to the spraying.

The Bureau of Entomology and Plant Quarantine will probably make a more complete report covering entomological phases of the work and the results of the spray job at a later date.

L. BEAMAN

cc: Bitterroot
Evenden

Evenden:

We are attaching a copy of the Bitterroot report. You will no doubt want to make some changes regarding entomological phases and you may want to leave out some paragraphs in your report. The items of expense are as nearly correct as possible. I am sure you will want to cut out some of the narration in the report you put out for industry. Perhaps we should look at your rough draft before you put it out?

Rolland Huff